FY03 STAR Physics Run Data Goals

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Outline:

Expected RHIC Collider Performance[1]

A few simple calculations of "environment" variables

STAR Data set goals for d-Au Run[2]

STAR Data set goals for pp run[2]

Ref.:

1) http://www.c-ad.bnl.gov/RHIC/retreat2002/CLOSE-OUT%20talks/01_ROSER.PDF

2) http://www.star.bnl.gov/STAR/smd/bur_fy03.pdf

Expected RHIC Collider Performance[1]

RUN2003 Goals (~ 3-4 weeks into run)

- Prepare for four modes; all with:
  Energy/beam: 100 GeV/nucl., diamond length: σ = 20 cm, L_{ave}(week)/L_{ave}(store) = 40 %

Mode	# bunches	Ions/bunch [$\times 10^9$]	β^* [m]	Emittance [$\pi\mu$m]	L_{peak} [$cm^{-2}s^{-1}$]	L_{ave}(store) [$cm^{-2}s^{-1}$]	L_{ave} (week) [$week^{-1}$]
Au-Au	56	1	1	15-40	14×10^{26}	3×10^{26}	70 $(\mu b)^{-1}$
(p↑-p↑)*	112	100	1	25	16×10^{30}	10×10^{30}	2.8 $(pb)^{-1}$
d-Au	56	100(d), 1(Au)	2	20	5×10^{28}	2×10^{28}	5 $(nb)^{-1}$
Si-Si	56	7	1	20	5×10^{28}	2×10^{28}	5 $(nb)^{-1}$

* Beam polarization ≥ 50 %; Acceleration test to 250 GeV

- Minimum: performance at end of FY2001/02 run
- Maximum: luminosities from previous slide

Mode	L_{ave} (week) [$week^{-1}$]	Int. Lumi. 2 modes	Int. Lumi. 3 modes	L_{ave} (week) [$week^{-1}$]	Int. Lumi. 2 modes	Int. Lumi. 3 modes
Au-Au	24 $(\mu b)^{-1}$	168 $(\mu b)^{-1}$	72 $(\mu b)^{-1}$	70 $(\mu b)^{-1}$	490 $(\mu b)^{-1}$	210 $(\mu b)^{-1}$
(p↑-p↑)*	0.3 $(pb)^{-1}$	2.1 $(pb)^{-1}$	0.9 $(pb)^{-1}$	2.8 $(pb)^{-1}$	19.6 $(pb)^{-1}$	8.4 $(pb)^{-1}$
d-Au	?	?	?	5 $(nb)^{-1}$	35 $(nb)^{-1}$	15 $(nb)^{-1}$
Si-Si	?	?	?	5 $(nb)^{-1}$	35 $(nb)^{-1}$	15 $(nb)^{-1}$

A few simple calculations of "environment" variables

- **d-Au Cross section estimate:**

  Brandt-Peters Formula $\sigma = \pi r_0^2 (A_1^{.33} + A_2^{.33})^2$ $r_0 = 1.2$ fm

  $= 2.26$ b

- **Expected "average" interaction rates for d-Au:**

  Rate $= L_{ave} * \sigma = (2 \times 10^{28}\ cm^{-2}\ s^{-1})(2.26 \times 10^{-24}\ cm^2)$

  $= 45{,}000$ Hz

  "Peak" rate may be ~ 110,000 Hz

- **Sixty bunch pattern planned for d-Au running** ⇒ **~213 ns between bunch crossings**

- **Expected "average" interaction rates for pp:**

  Rate $= L_{ave} * \sigma = (1 \times 10^{31}\ cm^{-2}\ s^{-1})(40 \times 10^{-27}\ cm^2)$

  $= 400{,}000$ Hz (note comment from Roser on previous slide)

  "Peak"rate may be ~ 640,000 Hz

- **120 bunch pattern planned for pp running** ⇒ **~107 ns between bunch crossings**

STAR Physics Data set goals for d-Au Run^2

- **Basic statement of Physics goals for d-Au data set:**

1.) Minimum bias spectra for $h_{\pm}$ and π^0 out to P_t of ~ 9-10 GeV/c

2.) Triggered spectra for $h_{\pm}$, π^0, and jets out to P_t of ~ 25, 20, and 40 GeV/c respectively

- **To achieve goal #1 above it is estimated that we need ~ 70 M min bias events.**

10 weeks of data taking, at a rate of 30 Hz, with combined RHIC/STAR uptime of 40%

(70 days)(24 hr/day)(3600 s/hr)(30 Hz)(0.4) = 72,576,000 evts

Minimum Luminosity required ~ 4 x 10^{25} cm^{-2} s^{-1} (< 1% of projected L by RHIC)

- **To achieve goal #2 above: It is estimated that we need to run a "high tower" EMC trigger, with a threshold of ~ 5 GeV π^0 equivalent response, for an integrated luminosity of 25 nb^{-1} or more.**

10 weeks of data taking, at a L of ~ 1 x 10^{28} cm^{-2} s^{-1}, with combined RHIC/STAR uptime of 40%

5 weeks of data taking, at a L of ~ 2 x 10^{28} cm^{-2} s^{-1}, with combined RHIC/STAR uptime of 40%

Conclusion: Most likely case is that we will have to run with "mixed" triggers.

To reconstitute min bias data set, and normalize triggered data, it will require new features of Run Control, scalers, and additional data sent to Database

STAR Data set goals for pp run^2

- **Basic statement of Physics goals for polarized pp data set:**
  1.) Collider related Spin commissioning. (~ 3 weeks, after 2 weeks of pp setup)
  2.) Measurement of forward π^0 asymmetries for vertically polarized pp. ($\int L$ ~1 pb^{-1}, ~ 1 week)
  3.) Tuning of Spin rotators for longitudinal polarization. ($\int L$ ~3 pb^{-1}, ~ 2 weeks)
  4.) First attempt to measure ΔG with longitudinally polarized pp.
  5.) Inclusive pp comparison spectra out to P_t of ~ 10 GeV/c.
- **For achieving goal #2 above the triggers needed are:**
  - FPD trigger (Inclusive data set without TPC, as well as data set with TPC)
- **For achieving goals #3 and #5 above the triggers needed are:**
  - pp minimum bias
  - Jet trigger (threshold TBD)
- **For achieving goal #4 above the triggers needed are:**
  - Jet trigger (threshold TBD)
  - High Tower trigger (threshold TBD)
  - pp minimum bias
  - FPD trigger

Summary

Triggers needed:

d-Au:

- **minimum bias trigger**
- **high tower EMC trigger (threshold ~ 5 GeV equiv. π^0 energy)**

pp:

- **minimum bias trigger**
- **FPD trigger**
- **high tower EMC trigger**
- **Jet trigger**

For d-Au data set, and perhaps for pp data sets as well, it appears that we will have to run with mixed triggers. This will require the use of the new Run Control features, the scalers, and additional counters saved into the data bases to reconstitute minimum bias triggers and normalize triggered data sets.